TECHNICAL MEMORANDUM

To: Dan Heister, On-Scene Coordinator
From: Julie Wroble, Toxicologist
Re: Activity-Based Air Sampling Results at North Ridge Estates, Klamath Falls, Oregon
Date: October 27, 2004

Introduction

This memorandum presents a brief summary of the results of activity-based sampling conducted by the U.S. Environmental Protection Agency (EPA) at the North Ridge Estates (NRE) site.

Activity-Based Sampling Objectives

Workers dressed in appropriate personal protective equipment mimicked outdoor activities conducted by residents to determine whether asbestos fibers in soil could be released into the breathing space of individuals conducting these activities. Further, the levels of fibers measured in air were compared to screening levels to determine the potential health risks associated with these activities. The activities conducted included an adult worker mimicking a child playing with soil; weed trimming; and rototilling. EPA conducted the activity-based sampling consistent with the work plan developed by Ecology and Environment, Inc. (E & E 2004) at the NRE site.

Sampling Procedures

The work plan (E & E 2004) contains a detailed description of how sampling was to be conducted. For the child play scenario, a worker squatted near the ground, filled a bucket up with site soil, and then dumped the bucket onto the ground. Every 5 minutes, the worker rotated 90 degrees in attempt to limit the impact of meteorological factors, such as wind, on the sampling event. Filling the bucket and dumping was repeated 8 times over a sampling period of 40 minutes. This activity was repeated 3 times with new sampling filters.

For the weed-trimming scenario, a worker used a string trimmer to cut vegetation over an area of 51 feet by 102 feet. This area was divided into 9 grids that measured 17 feet by 34 feet. Within each grid, the worker faced one direction while they trimmed weeds for 5 minutes, and then rested for 2 minutes. The worker then moved into the next grid, rotated 90 degrees from the direction they previously faced and started trimming weeds again. This activity was repeated 3 times with new sampling filters.

For the rototilling scenario, a worker tilled earth over the same grids that had weeds trimmed. Earth was tilled for 3 minutes followed by a 3-minute rest period. Similarly to the weed-trimming scenario, the worker faced one direction while in the grid. When they moved to the next grid, they rotated their body 90 degrees. Rototilling was repeated 2 times with new sampling filters.

Workers dressed in appropriate PPE wore personal pumps initially set at 2 different flow rates. The intent of two flow rates was to prevent overloading of filters during monitoring. After the initial sampling, the field team decided to perform personal monitoring only at the lower flow rate (1.5 liters per minute) to minimize the potential for overloading filters.

Phase-contrast microscopy (PCM) was used in the field to check filters for loading prior to sending to a fixed lab for transmission electronic microscopy (TEM) analysis. Samples were collected on 0.8-micron pore size mixed cellulose ester filters fitted into standard sampling cassettes.

Ambient samples were collected using high-volume samplers placed around the work area. These samples were collected for a minimum of 8 hours at a flow rate of about 10 liters per minute.

Analytical Methods

Samples were field screened using PCM (Method 7400) to determine whether filters were too overloaded to be analyzed by a fixed lab using TEM, ISO Method 10312. TEM results were reported for all fibers detected greater than 0.5 microns in length. In some cases, filters that appeared to be overloaded with dust based on field PCM measurements were readable by TEM.

Results
Sampling results are available for 2 iterations of the child play activity, 3 iterations of the weed trimming activity, 2 iterations of the rototilling activity, and 3 ambient samples. One of the sampling results for the child play activity may be biased low because the sampling filter was inadvertently inverted following PCM analysis.

Table 1 (attached) shows the results of air sampling for the various activities conducted as part of this field event. Results are provided as PCME fibers and Protocol structures. To understand the potential health significance of these various fiber counts, screening levels included in the sampling plan (E & E 2004) also are included in this table. A description of how the screening levels were calculated is presented in Appendix A. The screening levels correspond to an excess lifetime cancer risk level of 1×10^{-4} for a child playing and a gardening scenario. Use of 1×10^{-4} as a benchmark is consistent with other asbestos sites, notably Libby, Montana (Weis 2001), and the World Trade Center site (COPC Work Group 2003). However, note that for protocol structures, an assumption about percent of fibers longer than 5 microns was made for determining the screening level and this assumption may not be appropriate for every sample.

This sampling event demonstrated that asbestos fibers in soil at NRE are released into the breathing zone when certain outdoor activities are conducted. In most cases, the detected levels of fibers do not exceed the screening level corresponding to a 1×10^{-4} excess lifetime cancer risk; however, Protocol structure concentrations in one of three samples analyzed for the weed trimming slightly exceeded the screening level. Note that this screening level assumes 10 hours per week, 50 weeks per year, for 30 years, which may be a high estimate of the time most NRE residents would spend trimming weeds.

Recommendations/Conclusions
The results generally do not indicate risk levels elevated above the high end of EPA's risk management range of 1×10^{-6} to 1×10^{-4}; however, they do indicate that fibers are released into air upon soil disturbance. Residents at NRE should continue to practice measures to limit exposures to ACM and asbestos fibers.

Given the ongoing exposures that may occur at NRE and the demonstration that fibers are released into the breathing zone upon disturbance, I recommend that remedial measures be considered to prevent or minimize ongoing exposures to the current and potential future residents in this community.

References:
Berman, D. Wayne, Ph.D., September 28, 2004, *Final Soil Sampling Results and Preliminary Risk Assessment for the North Ridge Estates Site, Klamath Falls, Oregon*.

Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Task Force Working Group, May 2003, World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks.

Ecology and Environment, Inc., June 2004, *North Ridge Estates, Draft Site-Specific Sampling Plan for Activity-Based Sampling*, Region 10 START Contract 68-S0-01-01, TDD: 03-07-0011.

International Organization for Standardization, 1995, *Ambient Air – Determination of Asbestos Fibres – Direct-transfer Transmission Electron Microscopy Method*, Reference No. ISO 10312:1995(E).

National Institute for Occupational Safety and Health, Method 7400, *Asbestos and Other Fibers by PCM*, Method 7400, Issue 2, NIOSH Manual of Analytical Methods (NMAM), Fourth Edition, 8/ 15/ 1994, http://www.cdc.gov/niosh/nmam/pdfs/7400.pdf.

Weis, Christopher P. Ph.D., DABT, July 9, 2001, Memorandum to Paul Peronard, On-Scene Coordinator, Libby Asbestos Site, *Fibrous Amphibole Contamination in Soil and Dust at Multiple Locations in Libby Poses an Imminent and Substantial Endangerment to Public Health: an Addendum to my Memorandum of May 10, 2000*.

Table 1 Sampling Results for Activity-Based Sampling North Ridge Estates Klamath Falls, Oregon					
Sample Number	**Activity**	**PCME Fibers (s/cc)**	**Screening Level (s/cc)**	**Protocol Structures (s/cc)**	**Screening Level (s/cc)**
04070004	Child Playing	0.014	0.05	0.088	0.1
04070006	Child Playing	0.015	0.05	0.087	0.1
04070012	Weed Trimming	0.003	0.02	0.003	0.04
04070014	Weed Trimming	<0.009	0.02	0.0087	0.04
04070015	Weed Trimming	0.0062	0.02	0.044	0.04
04080018	Rototilling	<0.0099	0.02	0.013	0.04
04070019	Rototilling	<0.010	0.02	0.013	0.04
04070023	Ambient	<0.0061	NA	<0.0042	NA
04070024	Ambient	<0.0053	NA	<0.0053	NA
04070025	Ambient	<0.0066	NA	<0.0066	NA

NA = Not applicable.
PCME = Phase-contrast microscopy equivalent. These fibers are longer than 5 microns, between 0.25 and 3 microns in width, inclusive, and have a 3-to-1 aspect ratio (length to width).
Protocol Structures are defined as those structures longer than 5 microns, with a width of less than or equal to 0.5 microns.
S/cc = structures per cubic centimeter.

APPENDIX A

CALCULATION OF SCREENING LEVELS FOR ASBESTOS FIBERS IN AIR TASK-BASED MONITORING ACTIVITIES

1.0 Basic Equations

Risk from inhalation exposure to asbestos fibers may be calculated using two alternative risk models (IRIS, Berman and Crump 2003). In either case, the basic equation is

Risk = C * UR * TWF

Where:

C = Concentration of fibers in air (f/ml)
UR = Unit Risk (risk per f/ml)
TWF = time-weighting factor (fraction of lifetime during which exposure occurs)

The target screening level can be calculated by revising the equation as follows:

SL = TR / (UR * TWF)

Where:

TR = Target cancer risk level

2.0 Calculation of Screening Levels

Each of the three input parameters needed to calculate the target Screening Level is discussed below, along with the resulting values.

Target Risk Level
The target risk level is a risk management judgment, and may depend on a number of factors. For the purposes of these calculations, the Target Risk was assumed to be 1E-04 (i.e., one in ten thousand).

Unit Risk
As noted above, there are two alternative methods for estimating cancer risk from asbestos, and hence there are 2 alternative values for UR:

IRIS (2003) identifies a unit risk of 0.23 per PCM fiber per ml

Berman and Crump (2003) identify a unit risk of 0.098 per TEM protocol structures per ml, assuming that 50% of the protocol structures are longer than 10 microns in length. This value is the average across males and females, smokers and non-smokers and also is based on exposures to chrysotile asbestos – the majority of structures identified at the site are chrysotile. Once the actual data are obtained, then a sample-specific approach will be used that correlates to the proper proportion of short and long structures and accounts for fiber types present (i.e., serpentine and amphibole).

Time-Weighting Factor
The TWF is the fraction of full time that exposure occurs. This depends on the assumed time, frequency, and duration of exposure. For the purposes of these calculations, the following assumptions were used:

Activity	Exposure Time (hr/day)	Exposure Freque (d/year)	Exposure Duratic (years)	Total hours	TWF
Total	24	365	70	613200	1.00
Playing in the Dirt	2	270	10	5400	0.0088
Gardening	10	50	30	15000	0.024

Note that these assumptions may not be identical to those that are used in the actual risk calculations. Rather, these were selected to represent a conservative estimate of the actual exposure associated with each scenario

Briefly, the values selected for these scenarios were based on the following references:

Playing in the Dirt: Exposure Factors Handbook, Table 15-58, the 90th percentile value of 120 minutes/d for children ages 1-11 was used for the exposure time. Best professional judgment about snow cover at the site was used to arrive at 270 days/year and the entire span of the age group was used for exposure duration.

Gardening: This scenario is based on the 95th percentile value for hours per month that adults garden as provided in the Exposure Factors Handbook, Table 15-62, combined with the standard EPA residential exposure duration.

Results

Based on these inputs, the target screening levels are as follows:

Activity	Screening Level	
	IRIS (PCM fibers/ml)	Berman and Crump (protocol fibers/ml)
Playing in the Dirt	0.05	0.1
Gardening	0.02	0.04

For the above, I assumed a Berman and Crump unit risk of 0.098 based on the assumption that 50% of the fibers are long and all are chrysotile.